# EStelar: Support for Teaching Software Engineering

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***Abstract:*** *Software Engineering is part of the Information Systems curriculum. However, studies highlight the difficulties in teaching this discipline due to the topic complexity and students' engagement. This work proposes a system to support SE teaching using gamification and collaboration. We will evaluate the system in the Information Systems course at UNIRIO and collect feedbacks using the TAM methodology (Technology Acceptance Model). As a result, it is expected a students' engagement increase and better preparation for market.*

## 1. Introduction

Software Engineering (SE) "includes a process, a set of methods and a range of tools that enable professionals to develop high-quality software" [Pressman 2011]. For this, the training of software professionals needs to include theoretical concepts, besides techniques and processes that teach how to define, develop, and maintain software [Saiedian 1999, ACM/IEEE 2008]. More than that, it encourages the use of alternative approaches that help in the student's learning [ACM/IEEE 2008], such as replacing expository classes with a discussion of practical cases [Gnatz et al. 2003], group dynamics, and games [Wangenheim and Shull 2009]. It is necessary because SE is not an exact science and depends on several factors, and software development faces difficulties such as complexity, compliance, mutability, and invisibility [Brooks 1987].

With technological advances, students are increasingly connected to the digital environment. Therefore, the traditional teaching model (teacher transmitting knowledge through speech and use of the board or slides) becomes monotonous and unproductive [Fava 2014]. The use of tools that integrate students in SE learning is not only a way to communicate with students better but also a mechanism for engagement, motivation, training, or modifying behavior [Zichermann and Cunnigham 2011], thus making students the actors in the learning process itself.

This work aims to support SE teaching using concepts of gamification and collaboration for improving teaching and students' engagement. For this, we have devised EStelar, a social network system that provides summaries of SE content and quizzes about acquired knowledge, besides allowing its community to share and comment on projects, thus creating a rich environment for student learning.

This paper is structured as follows: Section 2 introduces the active learning methodologies used in work; Section 3 details the methodology for the proposed system development and evaluation; Section 4 explains EStelar and the expected results with its application; finally, Section 5 presents the contributions of this project and future works.

## 2. Theoretical Foundation

SE disciplines have a dense theoretical-conceptual content [Lima et al. 2020]. Therefore, higher education institutions usually use expository and theoretical classes to teach, besides recommending additional readings and project development to retain the content presented – which is often carried out in a short time [Huang and Distante 2006]. However, this can cause students to have difficulties in real and more complex projects, thus facing complaints in the software industry that they are not prepared to perform their work efficiently [Portela et al. 2016 apud: Meira 2015].

Active methodologies (AM) may mitigate this theoretical density and streamline SE teaching. AMs are processes of knowledge, analysis, and decision interaction in which the teacher acts as a facilitator and students as knowledge managers [Bacich and Moran 2018]. They encourage students to become the protagonist of the learning process and develop skills to build intellectual and social autonomy [Pinto et al. 2013].

Among the active methodologies, this work focuses on collaborative learning and gamification for SE teaching. Collaborative learning is a pedagogical proposal in which students are partners in the learning process, forming a collaboration network for sharing knowledge and ideas, and the teacher is a guide in this process [Campos et al. 2003]. Gamification involves the insertion of design elements and game mechanics in non-playful contexts (for instance, points system, rankings, achievements, challenges, engagement, customization, and feedback), thus improving users' experience and motivation for achieving their goals [Deterding et al. 2011].

The literature presents some related works: SimulES [Figueiredo et al. 2006], a card game to understand the project managers' point of view when building teams and developing systems; Engsoft [Bessa et al. 2009], which uses problem-based learning for students solve questions in SE scenarios; ProcSoft [Moura 2014], a board game that simulates roles in a company and students must answer question according to their role.

## 3. Research Methodology

The work follows three steps: design, development, and evaluation. The design identified the need for reflecting on SE teaching, and we elicited a support system for SE teaching using gamification and collaboration concepts: EStelar. During EStelar development, the current stage of our project, the agile methodology was adopted, using Kanban to organize tasks, 2-week sprints, and prioritization of deliveries based on MVP (Minimum Viable Product). In evaluation, EStelar will be used in Bacharelado em Sistemas de Informação at UNIRIO (BSI-UNIRIO) to understand the students' and professors' perception of EStelar using TAM (Technology Acceptance Model) [Davis 1989]. For this, participants will use Estelar and answer a questionnaire, that allows knowing participants' profile and assessing the perceived usefulness, ease of use, and overall evaluation of EStelar. Results will provide opportunities for tool improvement.

## 4. Results

The main result of the work is EStelar, a system that aims to make SE teaching a process in which the student is the protagonist and is motivated to seek and share knowledge with its peers. It is expected that, with a more relaxed atmosphere and a fun theme, the SE teaching becomes more attractive from students' perspectives. To illustrate how ESTellar works, we introduce Gabriel, an Information Systems student at

UNIRIO (Figure 1). Gabriel accesses EStelar and signs up using his institutional email. After that, Gabriel meets Bob, the astronaut who will guide him on a space journey through SE. Gabriel can carry out the learning trail, which is composed of 6 modules (the 5 SE disciplines of the BSI-UNIRIO curriculum and a module for Knowledge Consolidation) and aims to provide material that motivates the student to seek more knowledge. Each module has an overview of the discipline and a 10-question quiz. Upon passing the module quiz (i.e., reaching more than 70 points in the quiz), Gabriel unlocks the next module, earns points for every correct answer, and upgrades his "level" (students start as "Software Pupil" and can reach "Software Master"). Both level progression and current title are visible only to the student, thus making gamification becomes engaging without encouraging comparison between students. Gabriel can also collaborate with his peers through the Project Feed by (a) sharing his projects from knowledge consolidation or (b) commenting on other students' projects with tips and improvement suggestions. Teachers and monitors approve the shared projects and are responsible for approving comments and deleting offenses. Teachers can also add content and questions in each module, which is a feature not available for students.

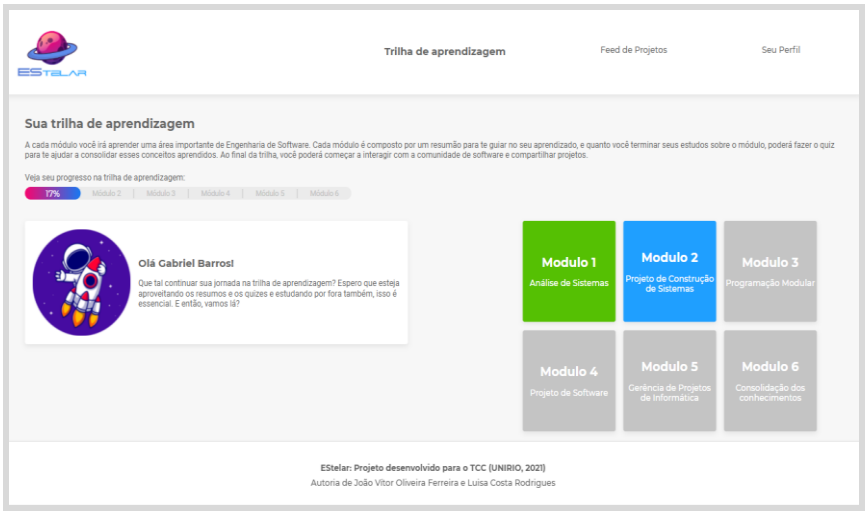


**Figure 1. EStelar Home Screen (students' view)**

## 5. Conclusion

The deficit in SE professionals' formation is a problem to be faced, either because of the area's dense content or the adopted teaching methodologies. To minimize such a situation, this paper proposed EStelar, a system that combines two active learning methodologies (gamification and collaboration) to support SE teaching, engage students, and create a favorable academic environment for knowledge sharing. As future work, we aim to conclude EStelar development, perform a study for EStelar evaluation in a real learning scenario, and improve EStelar based on the obtained results.

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